**Matching**

*Match the term with the correct definition below:*

a. thermochemistry
b. endothermic
c. specific heat capacity
d. closed system
e. exothermic
f. open system
g. temperature
h. first law of thermodynamics
i. isolated system
j second law of thermodynamics

a 1. the study of the energy changes involved in chemical and physical processes

c 2. the amount of energy needed to increase the temperature of one gram of a substance by one degree Celsiu

i 3. a system that cannot exchange either energy or matter with the surroundings

f 4. a system that can exchange both matter and energy with the surroundings

g 5. a measure of the average kinetic energy of all the particles of a sample of matter

d 6. a system that can exchange only energy with the surroundings

b 7. describes the process during which heat enters a system

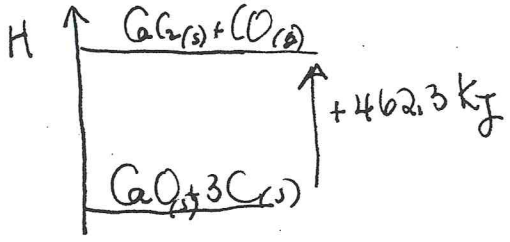
e 8. describes the process during which heat leaves a system

j 9. a law stating that when two objects are in thermal contact, heat is always transferred from the object at a higher temperature to the object at a lower temperature until the two objects are at the same temperature

___ 10. a law stating that the enthalpy change of a physical or chemical process depends only on the initial and fi conditions of the process

**Short Answer**

1. Create a simple enthalpy diagram to represent the following reaction.
$CaO_{(s)} + 3C_{(s)} + 462.3\ kJ \rightarrow CaC_{2(s)} + CO_{(g)}$




2. Explain how enthalpies of solution can be either positive or negative, depending on the solute.

If energy required to break intermolecular forces between solute molecules and solvent molecules is greater than the energy released when solute is attracted to solvent molecule, the enthalpy change would be positive ∴ endothermic solution

**Problem: Show all your work and respect the use of significant digits.**

1. 222 mL of water is placed in a calorimeter. A 0.169 g piece of solid lithium is added and the lid is replaced immediately. If the water was initially at 22.5 C, calculate the final temperature of the water if the molar enthalpy of this reaction is -636 kJ/mol of Lithium.

$\Delta H = -636$ kJ/mol $\quad n_{Li} = \frac{0.169\ g}{6.941\ g/mol} = 0.024348\ mol$

$Q_{system} = n \times \Delta H$

$= 0.024348 \times (-636)$

$= -15.49$ kJ

$Q_{solution} = -Q_{system}$

$= +15.49$ kJ

$Q_{solution} = mc\Delta T$

$15.49 = 222\ g \times 4.19\ J/g\,^\circ C \times \Delta T$

$15.49 = 930.18\ \Delta T$

$\frac{15490\ J}{930.18} = \Delta T$

$16.65 = \Delta T$

$T_F = \Delta T + T_i$

$= 16.65 + 22.5$

$= 39.15\ ^\circ C$

$= 39.2^\circ C$

2. Calculate the enthalpy change, when 10.5 g of bromine ($Br_{2\,(l)}$) reacts with an excess of phosphorus using the following information about the reaction: $P(s) + \frac{3}{2}Br_2(\ell) \rightarrow PBr_3\,(g)$ $\quad \Delta H = -121.5$ kJ

$\Delta H_{Br_2} = \frac{-121.5\ kJ}{1.5\ mol}$

$= -81$ kJ/mol

$n_{Br_2} = \frac{10.5\ g}{2(79.90)\ g/mol}$

$= \frac{105}{159.8}$

$= 0.06571\ mol$

$Q = \Delta H \times n$

$= -81 \times 0.06571$

$= -5.32$ kJ

3. A 100.00 mL sample of 0.200 mol/L NaOH(aq) is mixed with 100.00 mL containing an excess of $CuSO_4(aq)$. The initial temperature of both the solutions is 21.0 °C. After mixing the solutions in calorimeter, the temperature reached is 23.0 °C. Calculate the enthalpy change and write the thermochemical equation.

$CuSO_4(aq) + 2NaOH(aq) \rightarrow Cu(OH)_2 + 2Na_2SO_4(aq)$

$Q_{solution} = m_{H_2O} c_{H_2O} \Delta T$

$= 200.00\ g \times 4.19\ J/g°C \times 2.0°C$

$= 1676\ J$

$Q_{system} = -Q_{solution}$

$= -1676\ J$

$= -1.676\ kJ$

Finding Limiting Reagent:

NaOH since $CuSO_4$ is in excess

$n_{NaOH} = 0.10000\ L \times 0.200\ mol/L$

$= 0.0200\ mol$

$\Delta H_{Rxn} = \frac{Q_{system}}{n_{NaOH}}$

$= \frac{-1.676\ kJ}{0.0200\ mol}$

$= -83.8\ kJ/mol$

Thermochemical equation:

$CuSO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Cu(OH)_{2(s)} + 2Na_2SO_{4(aq)} + 168\ kJ$